PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of	Docket No: Q79936
Shin-ichi UEHARA, et al.	
Appln. No.: 10/782,928	Group Art Unit: 2872
Confirmation No.: 7682	Examiner: Audrey Y. CHANG
Filed: February 23, 2004	

For: THREE-DIMENSIONAL IMAGE DISPLAY DEVICE AND THREE-DIMENSIONAL IMAGE DISPLAY METHOD

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

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I. REAL PARTY IN INTEREST

The real party in interest is NEC Corporation, the assignee of the present application.

The assignment was recorded on February 23, 2004, at Reel 015023, Frame 0489.

II. RELATED APPEALS AND INTERFERENCES

Upon information and belief, there are no other prior or pending appeals, interferences or judicial proceedings known to Appellants' Representative or the Assignee that may be related to, be directly affected by, or have a bearing on the Board's decision in the Appeal.

III. STATUS OF CLAIMS

Claims 1-5, 11-15, 25-28 and 30-31 are pending in the application and stand rejected. Claims 6-10, 16-24 and 29 are canceled. Rejected claims 1-5, 11-15, 25-28 and 30-31 are the subject of this Appeal.

All of the claims subject to this appeal are set forth in their entirety in Appendix A, attached to this Brief on Appeal.

IV. STATUS OF AMENDMENTS

In the Amendment under 37 C.F.R. § 1.116 filed July 21, 2008, claim 29 was canceled. The Advisory Action issued August 1, 2008 indicates that this claim amendment was entered.

Thus, there are no outstanding non-entered amendments of the claims.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention is directed to a three-dimensional image display device and method wherein a user's visual fatigue is reduced. (*Specification*, p. 1, lines 9-13). In a three-dimensional display device, it is necessary that images having parallax from each other be presented for the right and left eye of a viewer. (*Id.*, p. 1, lines 24-27).

In an exemplary embodiment of the present invention as illustrated in FIGS. 4 and 5, the three-dimensional image is displayed using a parallax barrier 5 positioned in front of a display panel 6. (*Id.*, p. 17, lines 11-14). In this exemplary embodiment, the display panel 6 is a transmissive liquid crystal display of a rectangular shape extending in a vertical direction 11 and a horizontal direction 12. (*See* FIG. 4). On display panel 6, a plurality of pixels are arrayed in a matrix along both the vertical direction 11 and the horizontal direction 12. (*Id.* at lines 23-35). A portion of the plurality of pixels 23 display an image for the right eye and the other of the plurality of pixels 24 display an image for the left eye. (*Id.* at lines 25-28). Slits 5a are positioned on the parallax barrier 5 so that the plurality of pixels 23 are visible to the right eye and the plurality of pixels 24 are visible by the left eye. (*Id.*, p. 18, lines 12-20). In this way, a three-dimensional image is visible by a viewer.

However, as noted in the present specification, conventional methods of displaying three-dimensional images using parallax barriers results in viewer fatigue when images are viewed for an extended period of time. (*Id.*, p.8, lines 15-20). Committed to solving this fatigue problem, the present inventors, through experiments and research, found there is a relationship between the definition of a three-dimensional image and a viewer's fatigue. (*Id.*, p. 8, lines 15-20). It has

been recognized that feature points in the left and right images are an indispensable part of recognizing the three-dimensional image. (*Id.*, p. 8, lines 21-24). In particular, the perception of depth is based in the parallax of these feature points. (*Id.*, p. 9, lines 1-3). When the image lacks these feature points, a viewer experiences binocular rivalry, which results in confusion over which of the left or right images is given priority. When this occurs, the visibility of the three-dimensional image is reduced and the viewer becomes fatigued. (*Id.*, p. 9, lines 15-18).

As the result of conducting a thorough study, the inventors discovered that in order to prevent a lack of feature points, the definition of the three-dimensional image needs to be no less than the resolution of the eyesight of a viewer. (*Id.* p. 9, line 26 – p. 10, line 10). The minimum viewing angle of a viewer is 1/60 degrees. Thus, at an observation distance of D (mm) if the definition of the three-dimensional image is set to 25.4/ (D x tan(1/60 degree))(dot per inch) or more, the fundamental period of the image becomes smaller than the viewer's resolution, and the viewer's fatigue is reduced. (*Id.*, p. 10, lines 12-18).

The concise description of the claimed subject matter of the present invention is set forth below with regard to each of the respective independent claims 1 and 14. Each of the following discussions includes reference to various portions of the present application to aid in the understanding of the invention. However, such reference, unless otherwise indicated, is intended to point out the described exemplary embodiment; it is not intended to limit the scope of the claims to only the express embodiment cited below.

Independent Claim 1

Independent claim 1 includes a three-dimensional image display device 2 (*see* FIGS 4 & 5) including a display panel 6 where a plurality of pixel sections 23, 24, each of which includes pixels 23 displaying an image for a right eye 41 and pixels 24 displaying an image for a left eye 42, are arrayed in matrix form, the pixels sections being periodically arranged in a horizontal direction, (*Specification*, p. 17, line 19 through p. 18, line 10; FIGS. 4 and 5). The display device further includes an optical unit 5 that emits light emitted from the pixels 23 displaying said image for the right eye 41 and light emitted from the pixels 24 displaying said image for the left eye 42 in directions different from each other. (*Specification*, p. 13, lines 14-24, p. 18, lines 11-25; FIGS. 5 and 6). The display device 2 produces a three-dimensional visible range 7 which is defined as positions where a midpoint 43 between a viewer's right eye 41 and left eye 42 is positioned such that the light emitted from the pixels 23 displaying said image for the right eye 41 is made incident to said right eye 41 and the light emitted from the pixels 24 displaying said image for the left eye 42 is made incident to said left eye 42. (*Specification*, p. 19, line 15 through p. 20, lines 3; FIGS 5 and 6). Further, the pixel sections23, 24 are arrayed such that a number of pixel sections per inch in the horizontal direction 12 is configured such that a resolution of the image in the horizontal direction 12 as projected in the three-dimensional visible range 7 is no less than the resolution of the eyesight of a viewer whose midpoint 43 between the right eye 41 and the left eye 42 is positioned in said three-dimensional visible range 7. (*Specification*, p. 29, lines 5-9; FIGS. 5 and 6).

Independent claim 14

Claim 14 provides a three-dimensional image display method including arraying a plurality of pixel sections 23, 24 in matrix form on a display panel 6, in which one pixel 23 included in each pixel section 23, 24 displays an image for a right eye 41 and another pixel 24 displays an image for a left eye 42, the pixels 23 displaying said image for the right eye 41 and the pixels 24 displaying said image for the left eye 42 being periodically arranged in a horizontal direction (*Specification*, p. 17, line 19 through p. 18, line 10; FIGS. 4 and 5). The method further includes controlling light emitted from said pixel sections 23, 24 with an optical unit 5 such that light emitted from the pixels 23 displaying said image for the right eye 41 and light emitted from the pixels 24 displaying said image for the left eye 42, are in directions different from each other. (*Specification*, p. 13, lines 14-24, p. 18, lines 11-25; FIGS. 5 and 6). The method also includes positioning a midpoint 43 between the right eye 41 and the left eye 42 in a three-dimensional visible range7 , such that the light emitted from the pixels 23 displaying said image for the right eye 41 is made incident to said right eye 41 and the light emitted from the pixels 24 displaying said image for the left eye 42 is made incident to said left eye 42, wherein the pixel sections 23, 24 are arrayed such that a number of the pixel sections per inch in the horizontal direction 12 is configured such that a resolution of the image in the horizontal direction 12 as projected in the three-dimensional visible range7 is no less than the resolution of the eyesight of a viewer whose midpoint 43 between the right eye 41 and the left eye 42 is positioned in said three-dimensional visible range 7. (*Specification*, p. 29, lines 5-9; FIGS. 5 and 6).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(1) Whether claims 1, 3, 11-13, 14, 25, 27 and 30 are unpatentable under 35 U.S.C. § 103(a) over an alleged obvious modification of Ichinose (US 4,987,487).

(2) Whether claims 2, 4, 15, 26, 28 and 31 are unpatentable under 35 U.S.C. § 103(a) over Ichinose as applied above, in further view of Isono et al. (US 5,315,377).

(3) Whether claim 5 is unpatentable under 35 U.S.C. § 103(a) over Ichinose as applied to claims 2, 4, 15, 26, 28 and 31, in further view of Chikazawa (US 5,852,512).

(4) Whether claims 1, 3, 11-14, 16, 25, 27 and 30 are unpatentable under 35 U.S.C. § 103(a) over Momochi (US 5,528,429) in view of Ichinose.

(5) Whether claims 2, 4, 7, 15, 26, 28 and 31 are unpatentable under 35 U.S.C. § 103(a) over Momochi (US 5,528,429) in view of Ichinose as applied to claims 1 and 14, and in further view of Isono.

(6) Whether claims 5 is unpatentable under 35 U.S.C. § 103(a) over Momochi and Ichinose as applied to claim 1, and in further view of Chikazawa.

(7) Whether claims 25-28 and 30-31 are indefinite for reciting the coefficient "tan(1')".

VII. ARGUMENT

Appellants respectfully submit the present rejections are in error for the reasons set forth below.

I. Claims 1, 3, 11-13, 14, 25, 27 and 30 are patentable under 35 U.S.C. § 103(a) over an alleged obvious modification of Ichinose (US 4,987,487).

Appellants submit the Examiner has failed to establish prima facie obviousness for failing to establish *prima facie* obviousness. Specifically, the Examiner applies a reference Ichinose, which merely contemplates which pixel displays a left image or a right image in order to compensate for the movement of a viewer. Ichinose does not disclose any particular pitch with respect to the minimal angular separation (1/60 of a degree or one minute) which is discernable by a viewer. Rather, Ichinose is directed to changing which pixels display a right image or a left image to compensate for the right, left, forward and backward movement of a viewer. (col. 8, lines 22-48). Thus, Ichinose's intended use is to permit stereoscopic viewing by a viewer moving side to side and away from the display apparatus. Ichinose does not change the pixel pitch when the viewer moves closer to or further from a display, rather, Ichinose merely changes which pixels display the left and right images.

As a reason to modify Ichinose in view of the minimal angular separation discernable by a human, the Examiner provides the following comments:

> The applicant in particular argues the examiner fails to "articulate any rationale for modifying the definition of a three dimensional image based on the resolution of the eyesight of viewer", in considering the reasons of rejections based on cited Ichinose et al and Momochi references, the examiner respectfully disagrees. One skilled in the art or any ordinary person would understand that in order for the images provided by the pixels to be

> viewed by an observer with normal eyesight, the smallest separation of the pixels which is referred to be definition of the display, has to be greater than normal eyesight of human being. In fact, a general eyesight for a normal human being is 1.0, which means the minimum angular separation, is 1/60 degree or one minute. This is the limitation of the structure of human eyeball. So to make the definition greater than the normal eyesight of a human being is not irrational and is not hindsight since if such condition is not met then the image displayed by the display device cannot be viewed by an observer. Since the human eye cannot resolve the image.
>
> (*Final Office Action* of April 21, 2008, p. 16).

Failure To Establish Prima Facie Obviousness

In response, Appellants submit the Examiner's purported logical rationale is unsupported. In fact, it is well known that televisions/display monitors come in a multitude of display resolutions with the differences between resolutions being discernable by the human eye, i.e., high definition versus standard television viewing. The rationale that the resolution must be greater than that discernable by the human eye for an observer to be viewed is wholly unsupportable.

Further, objective evidence provided by the present inventors disclose that these allegedly obvious resolutions were not obvious or even desired. Specifically, the Examiner insists that raising the definition of an image display apparatus so that it is greater than the resolution by eyesight would have been obvious to one skilled in the art. However, pages 120 and 121 of Reference 1 (Vision Vol. 17, No. 2, pp. 113-122, 2005) (Submitted with the Amendment filed January 14, 2008) discloses "if the results of the study introduced this time are correct, currently where image quality has been improved with the advances in image technology, images have been improved to appear more natural in many points, which is preferable, however, in so far as

a stereoscopic image is concerned, it is doubtful whether an improvement in image quality (opposite to defocusing) increases the inconsistency between the accommodation and vergence to easily cause fatigue. In at least an accommodative reaction, a more accurate alignment with the screen surface would have become necessary. However, whether this leads to fatigue is still unknown. It seems that some researchers have such a sense that supports the relationship, however, since we have not asked many researchers about this, its examination will become a challenge in the future." (emphasis added) As far as three-dimensional images are concerned, a higher definition being preferable was not obvious or even desired. The reason is that a higher definition of three-dimensional images was believed to increase the inconsistency between the accommodation and vergence, which may cause fatigue. The inventors et al. eagerly conducted experiments and research in an effort to improve the visibility of three-dimensional images and reduce the fatigue of the viewer, and they proposed a lower limit of definition for three-dimensional images that could have been a solution to these problems.

In this way, the present inventors discovered that definition is more important for three-dimensional images than for two-dimensional images. In a three-dimensional image, binocular fusion is interrupted by differences between two images, so observers become more sensitive to such differences in three-dimensional image display than in two-dimensional image display. For example, when the display definition is low, the spatial frequency for display decreases, and in turn differences between two images increase. As a result, binocular fusion is interrupted, and the visibility of three-dimensional images decreases significantly.

Thus, Appellants submit modifying the display of Ichinose to produce an image having no less resolution than the eyesight of a viewer was not obvious or even desired by those of ordinary skill in the art.

Further, in the rejection, the Examiner relies on Ichinose, which discloses a method for adjusting or shifting pixel images for a left eye and a right eye in a stereoscopic image display. Ichinose performs the shifting to compensate for the movement of a viewer. To accomplish this adjustment, Ichinose detects the position of a moving body and adjusts the pixel positions for each of the left and right eye so that a proper stereoscopic image may be viewed. (Abstract, col. 1, line 58 through col. 2, line 20). Consequently, pixels displaying the left image may be changed to display the right image so that stereoscopic viewing is maintained. (col. 3, lines 45-55).

The Examiner alleges that Ichinose discloses many of the features recited in claims 1 and 14, but further relies on: (1) unsupported "geometry" based on Appellants' own disclosure; and (2) a further unsupported modification based on the contention that a minimum angular separation of eyesight of 1.0 or one minute is well known. As noted above, the Examiner has failed to articulate a valid reason as to why one of ordinary skill in the art would modify the pixel pitch in view of the minimum angular separation of the eyesight of a human, especially when the required pitch resolution would change when the viewer moves closer to or further from the display screen.

Within the rejection the Examiner allegedly derives the mathematical relationship $1/L>25.4/(DIS*\tan(a))(dpi)$ based on the disclosure of Ichinose. However, the Examiner

concedes that Ichinose fails to teach the recited equation X (dpi) ≥ 25.4/(D*0.000291). In fact, Ichinose fails to even mention a value which corresponds to X (dpi) dots per inch in relation to the distance D. More specifically, Ichinose fails to even establish any method for calculating how the pixel pitch is determined. Rather, Ichinose is directed to determining the pitch of each lenticular lens within a lenticular lens sheet based on a given pixel pitch array size.

To compensate for Ichinose's deficiencies, the Examiner alleges that it is well-known in the art that general eyesight is 1.0, which means a minimum angular separation, is 1/60 degree or one minute. However, without a valid rationale for doing so, the Examiner plugs this value into the equation 1/L>25.4/(DIS*tan(a))(dpi) to arrive at X ≥ 25.4/(D*0.000291) in a fashion similar to that disclosed in the present specification. However, the resulting equation calculated by the Examiner is based on hindsight gleamed from the present specification. There is simply no support within Ichinose or any other applied reference which supports the Examiners' combination of the minimum angle of separation to determine the recited equation X (dpi) ≥ 25.4/(D*0.000291). Nothing, other than hindsight gleamed from the present specification, would lead one of ordinary skill in the art to so modify Ichinose. In fact, reference 1 teaches away from such a modification and the Examiner's purported rationale based on the unsupported premise that the image could not be viewed unless this resolution is greater than that discernable by an observer.

Appellants submit that the Examiner fails to provide a valid reason to combine the minimum angle of separation with the derived mathematical expression as arranged in the claims. As a basic requirement of obviousness, the Examiner must articulate some rational basis,

found either in the references themselves or in the knowledge generally available to one or ordinary skill in the art, to combine the teachings as the Examiner attempts. MPEP §2143. Furthermore, the reason to combine cannot come only from Applicant's disclosure. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991).

However, the Examiner has failed to provide any such reason to combine. Furthermore, the only rational basis to make the combination attempted by the Examiner comes from the Appellants' own disclosure. Specifically, the present Application describes the study and discovery of the unrecognized problem related to the definition of a three-dimensional image and viewer fatigue. (specification, page 8, lines 15-20). As a result of this study, Appellants discovered that the visibility of the three-dimensional images had drastically reduced when the viewer significantly lacks perception of the corresponding feature points in the right and left images, which cause the fatigue. (specification, page 9, lines 2-7) Further, the Appellants discovered that to completely prevent the lack of feature points, the definition of the three-dimensional image need to be no less than the resolution by the eyesight of a viewer. (specification, pages 9 and 10).

Thus, Appellants recognized the problem of viewer fatigue and resolve this by combining the viewing geometries with the minimum viewing angle. While the Examiner appears to derive similar equations within the rejection, Appellants submit that this is a result of hindsight analysis based on the present specification as the Examiner has failed to provide any rational basis to support the derived combination.

More importantly, the Examiner misconstrues the applied references in this purported combination. Specifically, Appellants note the following errors with the Examiner's application of Ichinose:

(1) In the second paragraph of Page 5 of the Final Office Action, the Examiner provides:

> As demonstrated by Figure 8, the smallest separation between the two adjacent image pixel sections that can be resolved by the eyes so that one image from the first pixel to be directed to the left eye and the other image from the adjacent second pixel section to the right eye is indicated in Figure 8 as L. And the definition of the pixel section is defined as 1/L. From simple geometry one can calculate the definition of the pixel section as the following:

However, this is incorrect. Referring to FIG. 8 of cited reference U.S. 4,987,487, "the smallest separation between two adjacent image pixel sections" is not L but 2L. Accordingly, the definition of the pixel sections is not 1/L but 1/2L.

(2) In the last paragraph of Page 5 of the Office Action, there is a description "L+e=(f'*tan(a))+(D*tan(b)), for paraxial light, b=a, and tan(a) approximately equals to a in radians and tan(b) approximately equals to b in radians. And if the optical unit is a parallax barrier with slits instead of the lenticular lens, the angle a will be equal to angle b."

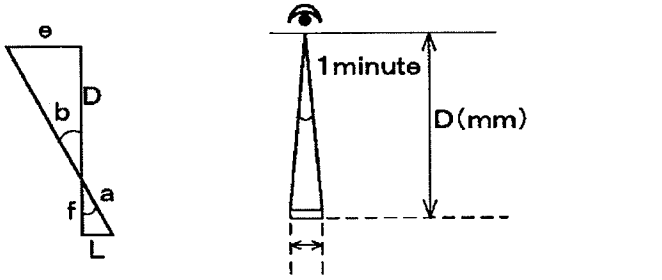
However, why L and e are added is unclear. Notably, the Examiner has failed to provide any rational basis to add L and e. Additionally, even when paraxial approximation exists, it can be said that tan(a) is approximately equal to a and tan(b) is approximately equal to b, but it cannot be said that b=a. Also, the angle of "b" is approximately 9 degrees when a=65mm and D=400mm and not on the order of minutes (one minute=1/60 degrees). Consequently, the Examiner's result here is unsupportable.

(3) There is also a description "if the optical unit is a parallax barrier with slits," however, why the discussion that assumes a parallax barrier is included when calculation of a lens is being discussed is unclear.

(4) Furthermore, there is a description "(f'+D)*tan(a)" in the 1st line of Page 6 of the Office Action, however, the reason why tan(a) remains despite the assumption that tan(a)=a is unclear. Therefore, the reason for transforming the expression as such is wholly unsupportable.

(5) Furthermore, there is a description "The definition of the pixel section (1/L)" in the 8th line of Page 6 of the Office Action, however, this is not (1/L) but, correctly, (1/2L) as described above.

(6) Furthermore, the Examiner provides, "This means the definition is 1/L>25.4(D'*tan(1')(dpi)." in the 12th and 13th lines of Page 6 of the Office Action, however, the left-hand side is not (1/L) but correctly, (1/2L) as described above. Therefore, the above inequality is unlikely to hold true. Also, with regard to (1') on the right-hand side of the above inequality, the reason why 1' (one minute) comes up here is unclear and unsupported. As described above, the Examiner argues that a=b. If so, "a" must be approximately 9 degrees as described above, and it cannot be one minute (1/60 degrees). Consequently, the Examiner application of "a" and "b" and 1 minute, is illogical. In this way, the Examiner appears to be illogically manipulating Ichinose to



a=b=9degrees (a)

Sepatron of pixel sections=2L (b)

arrive at the claimed invention as recited in claims 25-28 and 30-31.

(7) Finally, in the 17th to 20th lines of Page 9 of the Office Action, there is a description "The smallest separation ... is indicated in Figure 7 as Δ." However, in FIG. 7 of cited reference U.S. 5,528,420, Δ indicates the pitch (separation) of one of the pixels of a pixel section, and the pixel section has a pitch of q, and thus, q=3Δ.

Consequently, as set forth above, because the Examiner's reading of the applied references is erroneous, and the subsequent derivations in the Office Action are not supported by any logical rational, Appellants submit the Examiner has failed to provide the necessary objective evidence to establish a *prima facie* case of obviousness, and therefore, the rejection of claims 1, 3, 11-14, 25, 27 and 29-30 is in error and should be withdrawn.

Even If Combined As Suggested Not All Claim Features Disclosed

Second, even if modified as suggested by the Examiner, Ichinose fails to teach or suggest, at least, "wherein the pixel sections are arrayed such that a number of pixel sections per inch in the horizontal direction is configured such that a resolution of the image in the horizontal direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range," as recited in claims 1 and 14.

Specifically, Ichinose does not mention or even contemplate the resolution of the eyesight of a viewer. Rather, Ichinose is directed to producing the three-dimensional image properly to a viewer who moves left or right in a horizontal direction. In particular, Ichinose detects the binocular position of the viewer using a detection means so that the proper pixel for

the left eye image is always incident on the left eye and the proper pixel for the right eye image is always incident on the right eye. (col. 1, lines 60-67; col. 4, lines 10-23). Specifically, Ichinose discloses:

> [T[he right and left image array control circuit 25 forms a signal for controlling an array of a combined image on the display device based on a binocular position signal as an output from the binocular or head position detecting circuit 24 which detects the binocular or head position of the viewer, and applies the signal to the multiplex circuit 23 to control a combination of the binocular signals. The resultant signal is applied to the stereoscopic display device 26 to control an array of R and L pixels on the combined image 1, as shown in FIGS. 3 or 4. Therefore, the viewer can experience stereoscopic viewing even if he or she moves to the right or to the left.

(col. 5, lines 45-58).

Accordingly, Ichinose is directed to changing which pixels display a particular portion of the image in response to the left and right movement of a viewer. To the contrary, claims 1 and 14 are directed to the number of pixel sections per inch in the horizontal direction beings configured such that a resolution of the image in the horizontal direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer in order to prevent a lack of feature points. Consequently, the resolution of the eyesight of a viewer is not contemplated or mentioned in Ichinose. Further, assuming, *arguendo*, one of ordinary skill in the art would recognize the that general eyesight is 1.0, which means the minimum angular separation is one minute, even if this is combined with Ichinose, the combination fails to disclose any relationship between the "definition of the three-dimensional image in the horizontal direction" and "resolution by the eyesight of a viewer." In other words, Ichinose and the Examiner alleged well-known eyesight of a viewer, at most, would disclose the following:

(1) the resolution of the eyesight of a viewer is one minute (Examiner's contention); and

(2) changing which pixels display left and right images based on the movement of a viewer (Ichinose).

Accordingly, there is absolutely no disclosure related to the resolution of a viewer and the definition of a three-dimensional image.

Thus, because this feature is not disclosed or contemplated even if the reference is modified in view of the resolution of viewer being one minute, Appellants submit claims 1 and 14 are allowable over the suggested modification of Ichinose. Additionally, Appellants submit claims 3, 11-13, 25, 27 and 29-30 are allowable, at least because of their dependency.

Claim Rejections - 35 U.S.C. § 103(a)

The Examiner rejected claims 2, 4, 15, 26, 28 and 31 as being unpatentable over Ichinose as applied above, in further view of Isono et al. (US 5,315,377). Appellants respectfully traverse this rejection.

Because Isono, either taken alone or in combination with Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above, Appellants submit that claims 2, 4, 15, 26, 28 and 31 are allowable by virtue of their dependency.

Additionally, on page 7 of the Office Action, the Examiner contends "[i]t is implicitly true for square or rectangular type of pixel section, the same definition analysis disclosed above also applied for the vertical direction of the matrix to allow the image being resolved by the eyes of the observer to achieve stereoscopic viewing."

In response, Appellants previously submitted a reference (Reference 1) (Vision Vol. 17, No. 2, pp. 113-122, 2005), which provides objective evidence, that it had not always been considered that, when perceiving a three-dimensional image, an image having a higher resolution in the vertical and horizontal directions is preferable for visual perception.

In Reference 1 (Vision Vol. 17, No. 2, pp. 113-122, 2005), there is a description "As a feature different from that in a natural environment or of a two-dimensional image, a vergence or a retinal image difference occurs in a stereoscopic image due to provision of a binocular disparity and a visual object appears to protrude. However, the image exists on the screen surface, and misalignment with the screen surface in accommodation results in defocusing of the image. When this inconsistency in stimulation between the vergence and accommodation is considered to be the cause for fatigue, it goes well with the feature of the stereoscopic image. (Page 114 to Page 115)," there is a description "... a demand for accommodation due to defocusing was decreased. As a method for this, employed was a simple method for defocusing from a focusing mark ... the results indicate that the accommodative reaction approximates the position of protrusion in accordance with further defocusing from the mark. This can be understood that the demand for accommodation due to defocusing is weakened according to the defocusing. (Page 119), and there is a description "... if the results of the study introduced this time are correct, currently where image quality has been improved with the advances in image technology, images have been improved to appear more natural in many points, which is preferable, however, in so far as a stereoscopic image is concerned, it is doubtful whether an improvement in image quality (opposite to defocusing) increases the inconsistency between the

accommodation and vergence to easily cause fatigue. In at least an accommodative reaction, a more accurate alignment with the screen surface would have become necessary. However, whether this leads to fatigue is still unknown. It seems that some researchers have such a sense that supports the relationship, however, since we have not asked many researchers about this, its examination will become a challenge in the future (Page 120 to Page 121)."

As described in this Reference 1, it is not always a matter of course that a three-dimensional stereoscopic image would preferably has a high definition. Furthermore, this Reference 1 was published in 2005, where it could not be positively stated that a three--dimensional image should preferably have a high definition even after the elapse of two years since the priority date of the present application. This is objective evidence of the prevailing sentiment at a period of time following this priority date. Appellants submit this Reference 1 is objective evidence rebutting the Examiner purported case of *prima facie* obviousness.

Moreover, only as a result of repeated diligent experiments and study of the relationship between the definition of a stereoscopic image and viewer fatigue, as described in the specification of the present application, the inventors of the present invention obtained findings that it has been discovered that the visibility of the three-dimensional images had drastically reduced when the viewer significantly lacks perception of the corresponding feature points in the right and left images, which causes fatigue. Specifically, when the right and left eyes perceive images having a parallax from each other, the viewer searches for corresponding feature points. At this time, when the image significantly lacks feature points, the right and left images cannot correspond to each other, which causes viewer confusion. This confusion leads to binocular

rivalry as to which of the images observed by the right and left eyes has priority. Since a condition with binocular rivalry is an unstable condition where binocular fusion is impossible, the visibility of the three-dimensional images drastically reduces, and the viewer experiences fatigue. Therefore, for making stereoscopic viewing easy in order to reduce viewer fatigue, it is sufficient to prevent the lack of corresponding feature points in the right and left images. This allows the viewer to easily find the corresponding feature points in the right and left images, so that binocular rivalry can be prevented, and binocular fusion can consequently be easily attained.

Concretely, the constitution and effects have been reached as the inventors of the present invention have examined to what extent the lack of feature points can be permitted. In order to completely prevent the lack of feature points, it is necessary that the degree of definition of the three dimensional image be no less than the resolution of the eyesight of a viewer. This allows avoiding the phenomenon that the feature points that could have been perceived by the viewer cannot be perceived due to a low definition of the image so that the viewer lacks recognition of the feature points.

It has conventionally been a concern that the inconsistency between the vergence and accommodation may increase due to a high definition of the three-dimensional image and lead to fatigue. In order to cope therewith, the inventors of the present invention have discovered that fatigue can be reduced from a different viewpoint of a prevention of confusion in a feature point search and thus completed the present invention.

In Reference 1 described above, employed was a simple method for displaying a focusing mark in a defocused manner so as to decrease the demand for accommodation due to defocusing.

In such a simplified case using a mark, since the number of feature points in an image is small in the first place, even if the definition is lowered by defocusing, the right and left images can easily correspond to each other, so that the possibility of leading to binocular rivalry is considerably lowered.

On the other hand, in the present invention, a more realistic stereoscopic image is used as shown in, for example, FIG. 1. In such a display, since a large number of feature points exist, when the ratio of lacking increases due to a decline in definition, the right and left images can no longer correspond to each other to lead to binocular rivalry, so that the viewer experiences fatigue due to confusion. That is, in realistic three-dimensional images such as images that the viewer sees usually, it is important to prevent a lack of feature points.

Therefore, in such a stereoscopic image, the following three conditions exist. First, a condition where the definition is lowered such that most of the feature points are lacking, second, a condition where the definition is improved so that almost half of the feature points are not lacking, and third, a condition where the definition is improved no less than the resolution of the eyes so as to prevent a lack of feature points.

In the first condition, as described in Reference 1, the inconsistency between the vergence and accommodation is reduced, so that viewer fatigue may be reduced. In the second condition, since the inconsistency between the vergence and accommodation is further increased and confusion also occurs at the time of a feature point search, viewer fatigue increases. On the other hand, in the third condition, since a search for feature points becomes easier despite an increase in the inconsistency between the vergence and accommodation, fatigue is

comprehensively reduced. As such, with regard to the relationship between the definition of a three-dimensional image and an improvement in visibility, the visibility level relative to a change in definition has an inflection point, so that even though the definition is high, the visibility level is not improved, but is conversely lowered unless the definition is made equal to or higher than a predetermined definition. The present invention has presented a lower limit of the definition from such a viewpoint.

Moreover, in the present invention, the definition in the vertical and horizontal directions has been improved to the same extent, and as described in the specification of the present application, in the two directions orthogonal to each other of a display panel, the arrangement cycle of the respective pixels becomes not less than the viewer's minimum viewing angle, so that a lack of corresponding feature points in the right-eye and left-eye images can be more completely prevented, and as a result, the visibility of a three-dimensional image is further improved, and viewer fatigue can further be reduced.

Consequently, the above effects are enabled by the finding of the present invention that "preventing a lack of feature points can reduce viewer fatigue," and could not have been easily anticipated by those skilled in the art based on the conventional arts.

Thus, Appellants submit the Examiner's purported combination is unsupported for these additional reasons. Therefore, claims 2, 4, 15, 26, 28 and 31 are submitted to be allowable for at least this reason.

Claim Rejections - 35 U.S.C. § 103(a)

The Examiner rejected claims 5 as being unpatentable over Ichinose as applied above, in further view of Chikazawa (US 5,852,512). Appellants respectfully traverse this rejection.

Because Chikazawa, either taken alone or in combination with Ichinose, fails to compensate for the above noted deficiencies of Ichiose as applied to claim 1, Appellants submit claim 5 is allowable, at least by virtue of its dependency.

Claim Rejections - 35 U.S.C. § 103(a)

The Examiner rejected claims 1, 3, 11-14, 16, 25, 27 and 29-30 as being unpatentable over Momochi (US 5,528,429) in view of Ichinose. Appellants respectfully traverse this rejection.

Because Momochi, either taken alone or in combination with Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above, Appellants submit claims 1 and 14 are allowable, at least for the same reasons set forth above. Additionally, Appellants submit claims 1, 3, 11-14, 16, 25, 27 and 29-30 are allowable, at least by virtue of their dependency.

Claim Rejections - 35 U.S.C. § 103(a)

The Examiner rejected claims 2, 4, 7, 15, 26, 28 and 31 as being unpatentable over Momochi (US 5,528,429) in view of Ichinose as applied to claims 1 and 14 above, and in further view of Isono. Appellants respectfully traverse this rejection.

Because Isono, either taken alone or in combination with Momochi and Ichinose, fails to compensate for the above noted deficiencies of Ichinose as discussed above with regard to claims

1 and 14, Appellants submit claims 2, 4, 7, 15, 26, 28 and 31 are allowable, at least by virtue of their dependency.

Claim Rejections - 35 U.S.C. §103(a)

The Examiner rejected claim 5 as being unpatentable over Momochi and Ichinose as applied to claims 1, and in further view of Chikazawa. Appellants respectfully traverse this rejection.

Because Chikazawa fails to compensate for the above noted deficiency with regard to the Momochi/Ichinose combination, Appellants submit that claim 5 is allowable, at least because of its dependency.

Indefiniteness of Claims 25-28 and 30-31

In the Office Action, the Examiner contends claims 25-28 are indefinite since the claims fail to provide a physical meaning for the term "tan(1')". Appellants note that the Examiner alleges the claims are indefinite under a claim objection, but since indefiniteness is subject matter of a claim rejection under 35 U.S.C. § 112, second paragraph, Appellants address the indefinite issue in the brief.

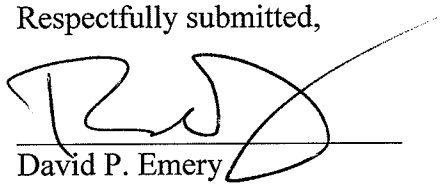
In response, Appellants submit that tan (1') does not have a physical meaning on its own. Rather, it is a unit-less numerical value. For example, like "2" is a non-unit-less coefficient in the expression 2X = 4, wherein X=2.

Thus, Applicants submit that these claims are definite and the Examiner's apparent rejection should be withdrawn.

Conclusion

The USPTO is directed and authorized to charge the statutory fee (37 C.F.R. §41.37(a) and 1.17(c)) and all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: November 20, 2008

CLAIMS APPENDIX

CLAIMS 1-5, 11-15, 25-28 and 30-31 ON APPEAL:

1. A three-dimensional image display device, comprising:

a display panel where a plurality of pixel sections, each of which includes pixels displaying an image for a right eye and pixels displaying an image for a left eye, are arrayed in matrix form, the pixels sections being periodically arranged in a horizontal direction; and

an optical unit that emits light emitted from the pixels displaying said image for the right eye and light emitted from the pixels displaying said image for the left eye in directions different from each other,

wherein a three-dimensional visible range is defined as positions where a midpoint between a viewer's right eye and left eye is positioned such that the light emitted from the pixels displaying said image for the right eye is made incident to said right eye and the light emitted from the pixels displaying said image for the left eye is made incident to said left eye, and

wherein the pixel sections are arrayed such that a number of pixel sections per inch in the horizontal direction is configured such that a resolution of the image in the horizontal direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range.

2. The three-dimensional image display device according to Claim 1, wherein pixel sections are arrayed such that a number of said pixel sections per inch in the vertical direction is

configured such that a resolution of the image in the vertical direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range.

3. (original): The three-dimensional image display device according to Claim 1, wherein said display panel is a liquid crystal display panel.

4. The three-dimensional image display device according to Claim 1, wherein said optical unit is a parallax barrier wherein a plurality of slits are periodically arranged in said horizontal direction.

5. The three-dimensional image display device according to Claim 1, wherein said optical unit is a lenticular lens that is arranged on the viewer side of said display panel, provided with a plurality of cylindrical lenses extended in a vertical direction and periodically arranged in said horizontal direction.

11. The three-dimensional image display device according to Claim 1, wherein said device displays a three-dimensional moving picture.

12. The three-dimensional image display device according to Claim 1, wherein said device is mounted in a portable device.

13. The three-dimensional image display device according to Claim 12, wherein said portable device is any one of a cellular phone, a portable terminal, a PDA, a game device, a digital camera, and a digital video camera.

14. A three-dimensional image display method, wherein:

arraying a plurality of pixel sections in matrix form on a display panel, in which one pixel included in each pixel section displays an image for a right eye and another pixel displays an image for a left eye, the pixels displaying said image for the right eye and the pixels displaying said image for the left eye being periodically arranged in a horizontal direction;

controlling light emitted from said pixel sections with an optical unit such that light emitted from the pixels displaying said image for the right eye and light emitted from the pixels displaying said image for the left eye, are in directions different from each other, and

positioning a midpoint between the right eye and the left eye in a three-dimensional visible range, such that the light emitted from the pixels displaying said image for the right eye is made incident to said right eye and the light emitted from the pixels displaying said image for the left eye is made incident to said left eye,

wherein the pixel sections are arrayed such that a number of the pixel sections per inch in the horizontal direction is configured such that a resolution of the image in the horizontal

direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range.

15. The three-dimensional image display method according to Claim 14, wherein the pixels sections are arrayed such that a number of said pixel sections per inch in the vertical direction is configured such that a resolution of the image in the vertical direction as projected in the three-dimensional visible range is no less than the resolution of the eyesight of a viewer whose midpoint between the right eye and the left eye is positioned in said three-dimensional visible range.

25. The three-dimensional image display device according to claim 1, when D(mm) is defined as the distance between said display panel and a point which is most distant from said display panel within said three-dimensional visible range, the number of pixels sections per inch (N)in said horizontal direction satisfies the expression of:

$N \geq 25.4/ D*tan (1')$.

26. The three-dimensional image display device according to claim 2, when D(mm) is defined as the distance between said display panel and a point which is most distant from said display panel within said three-dimensional visible range, the number of pixel sections per inch (M) in said vertical direction satisfies the expression of:

$M \geq 25.4/ D*\tan(1')$.

27. The three-dimensional image display device according to claim 14, when D(mm) is defined as the distance between said display panel and a point which is most distant from said display panel within said three-dimensional visible range, the number of pixel sections per inch (N) in said horizontal direction satisfies the expression of:

$N \geq 25.4/ D*\tan(1')$.

28. The three-dimensional image display device according to claim 15 when D(mm) is defined as the distance between said display panel and a point which is most distant from said display panel within said three-dimensional visible range, the number of pixel sections per inch (M) in said vertical direction satisfies the expression of:

$M \geq 25.4/ D*\tan(1')$.

29. (canceled).

30. The three dimensional image display device according to claim 25, wherein the optical unit is a lenticular lens having a refracting index n,

wherein when the pitch of a pixel section is defined as "2P", an interval between the right eye and the left eye is defined as "e", a distance between the lenticular lens and the pixel section is defined as "H", an incident angle from the end portion of a pixel group located at the center of

the display panel in a horizontal direction to a center of a cylindrical lens located at the center of the lenticular lens in a horizontal direction is defined as "α", an output angle from the center of the lenticular lens is defined as "β", and a maximum observation distance is defined as "D", the following expressions are satisfied,

$n \times \sin\alpha = \sin\beta$

$(D-H) \times \tan\beta = e$

$H \times \tan\alpha = P$.

31. The three dimensional image display device according to claim 26, wherein the optical unit is a lenticular lens having a refracting index n,

wherein when the pitch of a pixel section is defined as "2P", an interval between the right eye and the left eye is defined as "e", a distance between the lenticular lens and the pixel section is defined as "H", an incident angle from the end portion of a pixel group located at the center of the display panel in a horizontal direction to a center of a cylindrical lens located at the center of the lenticular lens in a horizontal direction is defined as "α", an output angle from the center of the lenticular lens is defined as "β", and a maximum observation distance is defined as "D", the following expressions are satisfied,

$n \times \sin\alpha = \sin\beta$

$(D-H) \times \tan\beta = e$

$H \times \tan\alpha = P$.

EVIDENCE APPENDIX:

Pursuant to 37 C.F.R. § 41.37(c)(1)(ix), submitted herewith are copies of any evidence submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 or any other evidence entered by the Examiner and relied upon by Appellant in the appeal.

NONE.

RELATED PROCEEDINGS APPENDIX

Submitted herewith are copies of decisions rendered by a court or the Board in any proceeding identified about in Section II pursuant to 37 C.F.R. § 41.37(c)(1)(ii).

NONE

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Shin-ichi UEHARA, et al.

Appln. No.: 10/782,928

Confirmation No.: 7682

Filed: February 23, 2004

Docket No: Q79936

Group Art Unit: 2872

Examiner: Audrey Y. CHANG

For: THREE-DIMENSIONAL IMAGE DISPLAY DEVICE AND THREE-DIMENSIONAL IMAGE DISPLAY METHOD

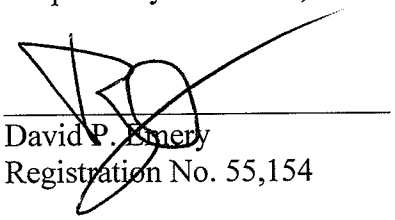
SUBMISSION OF APPEAL BRIEF

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith please find an Appeal Brief. The USPTO is directed and authorized to charge the statutory fee of $540.00 and all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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